

CLAIMS

What is claimed is:

1. An asymmetric Group 8 (VIII) metallocene of the general formula CpMCp' ,
 5 where

M is a metal selected from the group consisting of Ru, Os and Fe;

Cp is a first substituted cyclopentadienyl or indenyl moiety that includes at least one substituent group D_1 ;

10 Cp' is a second substituted cyclopentadienyl or indenyl moiety that includes at least one substituent group D_1' ;

wherein

D_1 is different from D_1' ;

D_1 is selected from the group consisting of:

X;

15 $\text{C}_{a1}\text{H}_{b1}\text{X}_{c1}$;

$\text{C}_{a2}\text{H}_{b2}\text{X}_{c2}(\text{C}=\text{O})\text{C}_{a1}\text{H}_{b1}\text{X}_{c1}$; and

$\text{C}_{a2}\text{H}_{b2}\text{X}_{c2}\text{OC}_{a1}\text{H}_{b1}\text{X}_{c1}$,

where

X is F, Cl, Br, I or NO_2 ;

20 a1 is an integer from 2 to 8;

b1 is an integer from 0 to $2(a1)+1 - c1$;

c1 is an integer from 0 to $2(a1)+1 - b1$;

$b1 + c1$ is at least 1;

a2 is an integer from 0 to 8;

25 b2 is an integer from 0 to $2(a2) + 1 - c2$;

c2 is an integer from 0 to $2(a2) + 1 - b2$; and

D_1' is selected from the group consisting of:

X;

$\text{C}_{a1}\text{H}_{b1}\text{X}_{c1}$;

$$C_{a2}H_{b2}X_{c2}(C=O)C_{a1}H_{b1}X_{c1}; \text{ and}$$

$$C_{a2}H_{b2}X_{c2}OC_{a1}H_{b1}X_{c1},$$

where,

X is F, Cl, Br or I or NO₂;

5 a₁ is an integer from 1 to 8;

b₁ is an integer from 0 to 2(a₁)+1 – c₁;

c₁ is an integer from 0 to 2(a₁)+1 – b₁;

b₁ + c₁ is equal to or greater than 1;

a₂ is an integer from 0 to 8;

10 b₂ is an integer from 0 to 2(a₂)+1 – c₂;

c₂ is an integer from 0 to 2(a₂)+1 – b₂; and

b₂ + c₂ is equal to or greater than 1.

2. The asymmetric metallocene of Claim 1 wherein either or both of Cp and Cp' includes at least one additional substituent, D_x, selected from the group consisting of:

X;

C_{a1}H_{b1}X_{c1};

C_{a2}H_{b2}X_{c2}(C=O)C_{a1}H_{b1}X_{c1};

20 C_{a2}H_{b2}X_{c2}OC_{a1}H_{b1}X_{c1};

C_{a2}H_{b2}X_{c2}(C=O)OC_{a1}H_{b1}X_{c1}; and

C_{a2}H_{b2}X_{c2}O(C=O)C_{a1}H_{b1}X_{c1},

where,

X is F, Cl, Br or I or NO₂;

25 a₁ is an integer from 0 to 8;

b₁ is an integer from 0 to 2(a₁)+1 – c₁;

c₁ is an integer from 0 to 2(a₁)+1 – b₁;

b₁ + c₁ is equal to or greater than 1;

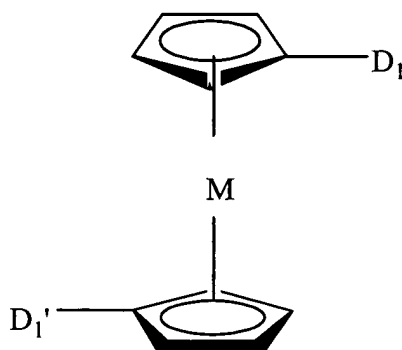
a₂ is an integer from 0 to 8;

b_2 is an integer from 0 to $2(a_2)+1 - c_2$;

c_2 is an integer from 0 to $2(a_2)+1 - b_2$; and

$b_2 + c_2$ is greater to or equal to 1.

- 5 3. A metallocene compound represented by the following molecular formula:



10 where

M is selected from the group consisting of Ru, Os and Fe;

D_1 is different from D_1' and D_1 and D_1' are independently selected from the group consisting of:

X ;

15 $C_{a_1}H_{b_1}X_{c_1}$;

$C_{a_2}H_{b_2}X_{c_2}(C=O)C_{a_1}H_{b_1}X_{c_1}$; and

$C_{a_2}H_{b_2}X_{c_2}OC_{a_1}H_{b_1}X_{c_1}$,

where

X is F, Cl, Br, I or NO_2 ;

20 a_1 is an integer from 1 to 8;

b_1 is an integer from 0 to $2(a_1)+1-c_1$

c_1 is an integer from 0 to $2(a_1)+1 - b_1$;

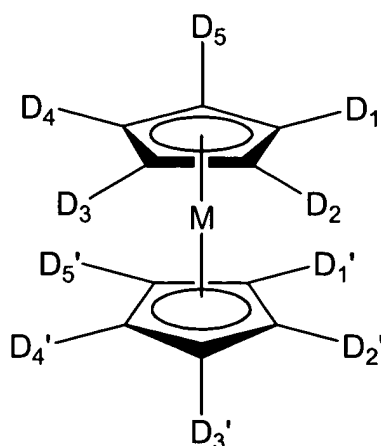
$b_1 + c_1$ is at least 1;

a2 is an integer from 0 to 8;

b2 is an integer from 0 to $2(a2) + 1 - c2$; and

c2 is an integer from 0 to $2(a2) + 1 - b2$.

- 5 4. The metallocene compound of Claim 3, wherein D_1 is methyl and D_1' is selected from the group consisting of ethyl, propyl, isopropyl, n-butyl, sec-butyl and tert-butyl.
- 10 5. The metallocene compound of Claim 3, wherein D_1 is ethyl and D_1' is selected from the group consisting of propyl, isopropyl, n-butyl, sec-butyl and tert-butyl.
6. The metallocene compound of Claim 3, wherein D_1 is propyl and D_1' is selected from the group consisting of isopropyl, n-butyl, sec-butyl and tert-butyl.
7. The metallocene compound of Claim 3, wherein D_1 is isopropyl and D_1' is selected from the group consisting of n-butyl, sec-butyl and tert-butyl.
- 15 8. The metallocene compound of Claim 3, wherein D_1 is n-butyl and D_1' is selected from the group consisting of sec-butyl and tert-butyl.
9. The metallocene compound of Claim 3, wherein D_1 is sec-butyl and D_1' is tert-butyl.
- 20 10. A compound of the general formula,



where D_1 and D_2 are different and each is independently selected from the group consisting of:

X ;

5

$C_{a1}H_{b1}X_{c1}$;

$C_{a2}H_{b2}X_{c2}(C=O)C_{a1}H_{b1}X_{c1}$; and

$C_{a2}H_{b2}X_{c2}OC_{a1}H_{b1}X_{c1}$.

where

X is F, Cl, Br I or NO_2 ;

10

a_1 is an integer from 1 to 8;

b_1 is an integer from 0 to $2(a_1)+1 - c_1$

c_1 is an integer from 0 to $2(a_1)+1 - b_1$;

$b_1 + c_1$ is at least 1;

a_2 is an integer from 0 to 8;

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b_2 is an integer from 0 to $2(a_2) + 1 - c_2$;

c_2 is an integer from 0 to $2(a_2) + 1 - b_2$; and

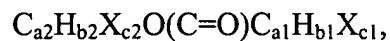
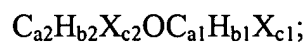
each of D_2 , D_3 , D_4 , D_5 , D_2' , D_3' , D_4' , and D_5' is independently selected from the group consisting of:

X ;

20

$C_{a1}H_{b1}X_{c1}$;

$C_{a2}H_{b2}X_{c2}(C=O)C_{a1}H_{b1}X_{c1}$;



where,

5

X is F, Cl, Br, I or NO₂;

a₁ is an integer from 0 to 8;

b₁ is an integer from 0 to 2(a₁)+1 – c₁;

c₁ is an integer from 0 to 2(a₁)+1 – b₁;

b₁ + c₁ is equal to or greater than 1;

10

a₂ is an integer from 0 to 8;

b₂ is an integer from 0 to 2(a₂)+1 – c₂;

c₂ is an integer from 0 to 2(a₂)+1 – b₂;

b₂ + c₂ is equal to or greater than 1.